CENTRAL ASIA NATURAL RESOURCES MANAGEMENT PROGRAM
TRANSBOUNDARY WATER AND ENERGY PROJECT

SUPPORT TO ELECTRICITY LOSS REDUCTION IN THE KYRGYZ REPUBLIC

STAGE I: IDENTIFICATION OF DEMONSTRATION PROJECTS

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U.S. Agency for International Development
Regional Mission for Central Asia
Office of Energy and Water
Park Palace Building
41 Kazybek bi Street
Almaty, Kazakhstan 480091
(7-3272) 50-76-17

Prepared by:

PA Consulting Group
209A Tynystanova Street
Bishkek, Kyrgyzstan 720040
(996-312) 66-30-85/86

and

PA Government Services
1750 Pennsylvania Avenue NW
Suite 1000
Washington DC 20006-4506
(202) 442-2000

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List of Acronyms

ADB	Asian Development Bank
CHP	Combined Heat and Power Plant
CSAC	Consolidated Structural Adjustment Credit
CT	Current Transformer
DDP	Distribution Demonstration Project
HPP	Hydro Power Plant
HVL	High Voltage Lines
HVN	High Voltage Network
IBRD	International Bank for Reconstruction and Development
ICWC	Interstate Commission for Water Coordination
IDA	International Development Association
JSC	Joint Stock Company
MB&C	Metering, Billing and Collection
NGK	National Grid of Kyrgyzstan
NRMP	Natural Resources Management Program
O&M	Operation and Maintenance
PCCAR	Power Council of Central Asia Republics
SEA	State Energy Agency
TDP	Transmission Demonstration Project
TO	Task Order
TPP	Thermal Power Plant
TWEP	Transboundary Water and Energy Project
UDC	Unified Dispatch Center
UPSCAR	United Power System of Central Asia Republics
USAID	United States Agency for International Development
USAID/CAR	USAID Mission for Central Asia
WB	World Bank

Measures and Equivalents

bcm	billion cubic meters
Gcal	Gigacalorie (=10^9 cal)
GWh	Gigawatt hour (=10^9 Wh)
kV	kilovolt (= 10^3 V)
kWh	kilowatt hour (= 10^3 Wh)
mcm	million cubic meters
MW	Megawatt (= 10^6 W)

US$1 = 46,3 som (as of September, 2002)

EXECUTIVE SUMMARY

Background

The electricity system of the Kyrgyz Republic was developed as part of the Central Asia Interconnected Power System of the former Soviet Union, which in turn was part of a complex system for the interstate optimization of energy and water resources. Until the break-up of the Soviet Union about 60% of the electricity demand in the Kyrgyz Republic was for industrial and agricultural use and was met by the Toktogul hydroelectric plant and four downstream hydroelectric plants. This hydroelectric system on the Naryn River, the main tributary of the Syr Darya, is known as "the Naryn Cascade". The remainder of demand was supplied by combined heat and power (CHP) thermal power plants in Bishkek and Osh, which also produce steam for district heating systems. The CHP plants depend on imported gas from Uzbekistan and coal from Kazakhstan.

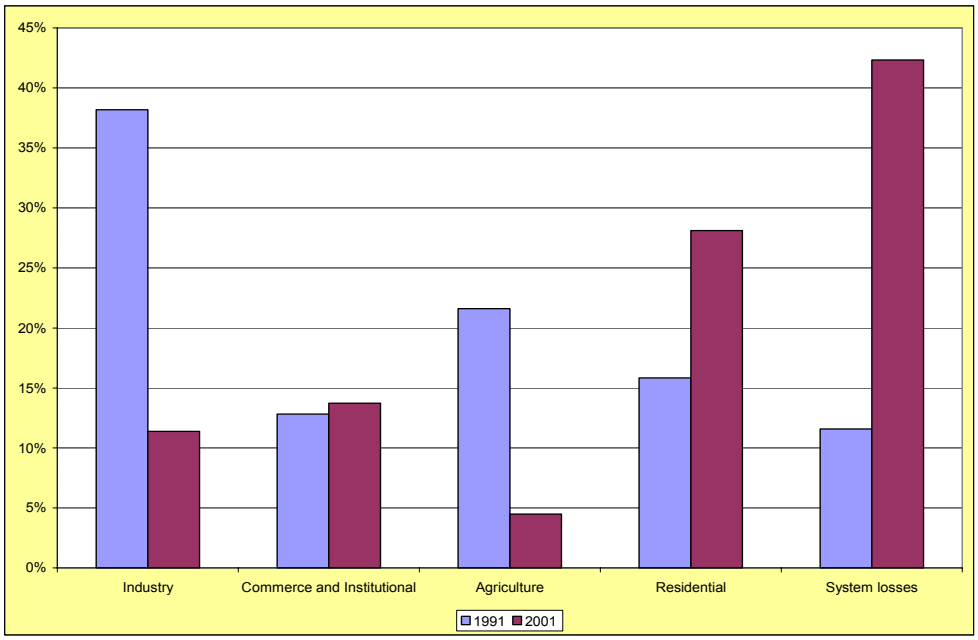
The Toktogul plant has a reservoir with a storage capacity of 19.5 km^3 located at the head of the Naryn Cascade. Peak water releases from this reservoir were made during the summer for irrigation in Uzbekistan and Kazakhstan and, to a smaller extent, in Tajikistan and the Kyrgyz Republic. An integrated 500-kilovolt-power system balanced the seasonal hydroelectric output with that of the thermal power plants in Uzbekistan, Kazakhstan and Turkmenistan. The winter fuel needs of the Kyrgyz CHP plants were supplied by oil and coal from Kazakhstan and natural gas from Uzbekistan and Turkmenistan.

Since independence in 1991, the demand patterns and the fuel-energy balance of the Kyrgyz Republic have changed drastically. Due to complications in intergovernmental relations and account settlements, introduction of national currencies, rising prices of oil, coal, natural gas and higher transportation costs, the supply of fuel to the Kyrgyz Republic was reduced. In addition, the Kyrgyz Republic lost foreign markets for most of its exports, dropping by more than 60% the electricity demand for industrial and agriculture uses, and leaving little foreign exchange to purchase fuel.

Due to fuel shortages the output of the CHP plants was halved, giving rise to increased electric power demand by the population for heating, hot water supply and cooking. The drop in the demand of the industrial and agriculture sectors was more than offset by rapid growth of residential demand, stimulated by very low tariffs, displacing more traditional energy resources for heating, hot water and cooking. Since electricity losses are higher in the residential sector this also contributed to a four-fold increase in losses.

The dramatic redistribution of demand among consumer groups and the corresponding growth in losses within the last ten years is illustrated in Figure 1. This figure is based on data provided by the State Energy Agency and shows a staggering level of losses of 42% of the power produced or imported by the Kyrgyz Republic.

Figure 1. Post-Independence Load Redistribution and Losses



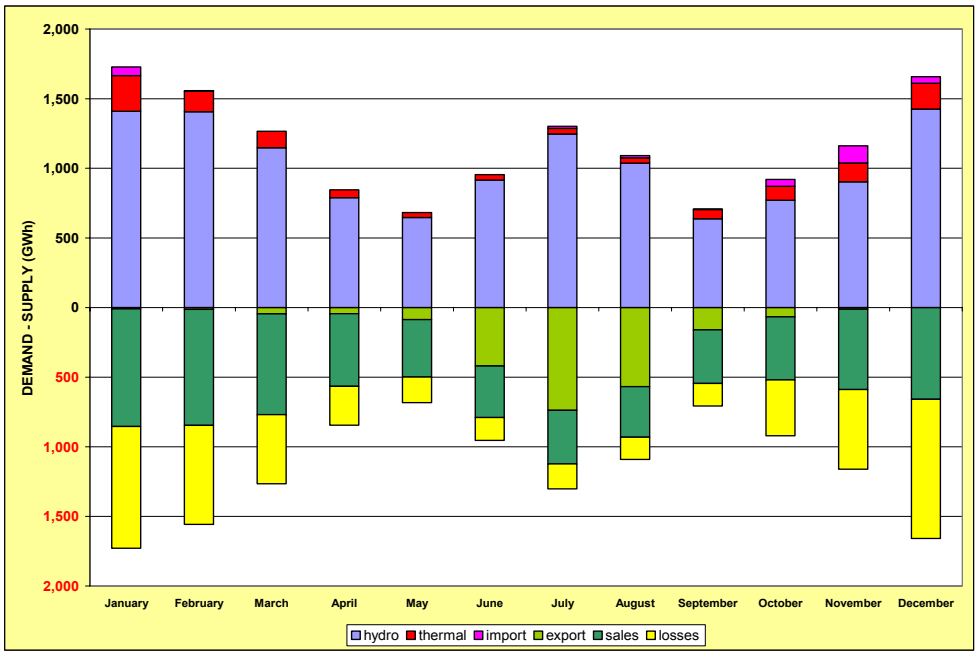
Issues

This redistribution of demand resulted in a marked increase in the seasonal variation of the load. The result in terms of current supply-demand balance of electricity in the Kyrgyz Republic is shown in Figure 2 that presents the sources and uses of electricity on a monthly basis. Figure 2 shows that there is now a ratio of 3 to 1 between the month of highest demand (January) and that of lowest demand (May). This large seasonal variation and the low revenues from electricity sales have contributed to interstate water management problems and an accelerated deterioration of the distribution networks.

Interstate water/energy issues. To meet the high winter demand for electricity, the operation mode of the Toktogul Reservoir was switched from irrigation to electricity generation, which requires major water releases during winter when power demand is highest. The Syr Darya river system cannot handle the high winter releases because its reservoir capacity is limited and the carrying capacity of the Syr Darya in Kazakhstan is restricted by ice formations. As a result, since 1991 about 30 km^3 of water had to be wasted into the Arnasay depression in Uzbekistan. The corresponding reduction in summer releases from the Toktogul Reservoir contributed to considerable water stress in Uzbekistan and Kazakhstan.

To address these problems, the Kyrgyz Republic, Uzbekistan and Kazakhstan have been entering into annual agreements on fuel deliveries to the Kyrgyz Republic in return for exports of hydro electricity. Since 1999, the agreed water and energy exchanges have been implemented reasonably well. Fuel has been delivered to the Kyrgyz Republic as required, albeit with occasional delays. Nevertheless, there is still a shortage of fuel for winter electricity generation in the Kyrgyz CHP plants; downstream countries still report irrigation water shortages; and losses in the Arnasay depression remain high.

Figure 2. Electricity Demand Supply Balance in 2001



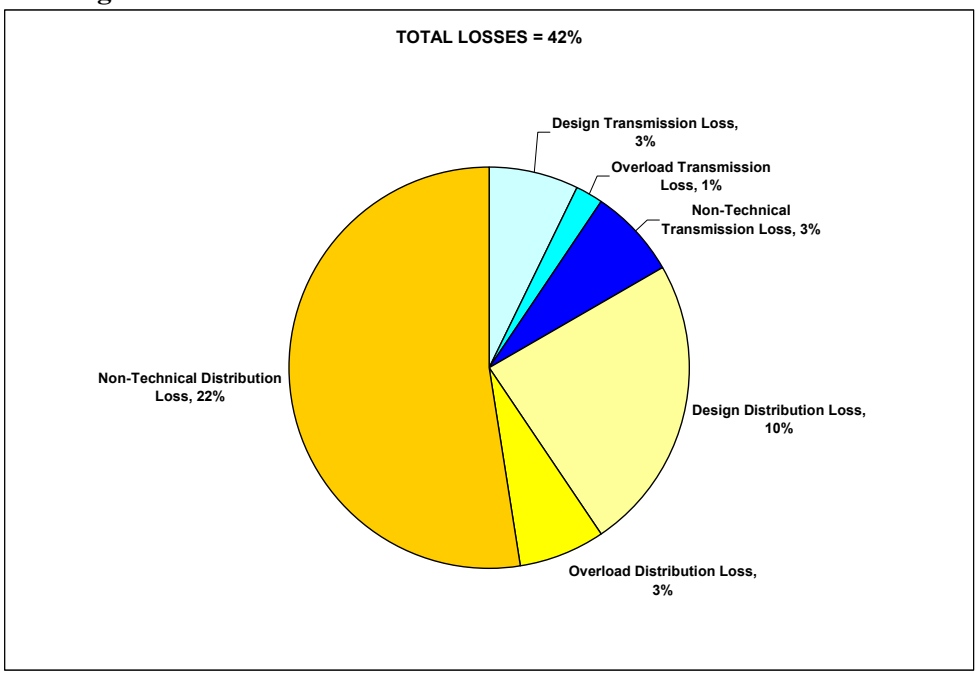
Deterioration of the distribution systems. Many adverse features of the transmission and distribution system of the Kyrgyz Republic are a direct consequence of the soviet approach to economics characterized by low capital cost allocation and a relatively higher allocation of cost to operation and maintenance. As a consequence the system includes extensive 6/10 and 0.4 kilovolt lines resulting in a design loss in the range of 13%. This design characteristic leading to high technical loss was accompanied by low construction quality, leading to faster deterioration of structures, lines and substations.

Overloading of the systems to meet the high winter demand during the last ten years has accelerated the deterioration process and increased the number of service interruptions. About 30% of the distribution systems need to be rehabilitated or replaced. In addition, technical losses have increased through overloading of lines and by redirecting power through lower voltage circuits to meet the changing distribution of load among user categories.

Yet the problem of increase in technical losses is minor in comparison with the serious problem of non-technical losses through lack of metering, inaccurate metering, fraud and inability of the utilities to properly track power flows and pinpoint problems. Figure 3 shows an estimate of the sources of losses in the Kyrgyz system. It shows that the overload of the transmission and distribution systems may account for about 4% over the design level losses, while non-technical losses amount to 25% loss over the technical loss level.

Low revenues. Tariffs are low, less than 1 US cent per kilowatt-hour. The current rate schedule is unnecessarily complex and not supported by metering infrastructure. In addition, many transactions are still based on barter with a high potential for corruption enhanced by the lack of regulatory incentives for efficient management. The resulting low revenue limits the possibilities of the energy providing companies to improve their systems and purchase fuel to increase output from the CHP plants.

Figure 3. Estimated Sources of Losses



In conclusion, the heavy dependence on hydroelectric power, the shift to a more seasonal demand pattern, low revenues, regulatory deficiencies and the seasonally conflicting demands on the use of water for power and agriculture, have had a detrimental effect on technical operations and the economic outlook of the sector. One of the most promising measures to rapidly mitigate this condition is to reduce the high level of technical and non-technical losses.

Ongoing and Planned Action

The Kyrgyz Government, concerned about the difficult situation of the electricity sector, has established a commission integrated by the national transmission company, the four distribution companies, and the State Energy Agency tasked to define a "Plan of Measures to Stabilize the Situation of the Electricity Sector". The commission has recently prepared an extensive list of actions to be undertaken and assigned responsibilities to the various energy system companies for their execution. A substantial number of the proposed measures are targeted at reducing technical and non-technical system losses.

The World Bank, as part of the monitoring of compliance on the terms of the Consolidated Structural Adjustment Credit (CSAC) is assisting distribution companies in implementing the actions with funding from the CSAC. In addition, the World Bank and Government agreed to allocate US$ 5 million from the remaining budget of the Power and District Heating Rehabilitation Project for equipment and materials to reduce electricity losses in the distribution systems.

Considering these initiatives and their relevance to the management of interstate water and energy resources, a subtask of USAID's Transboundary Water and Energy Project was established for Support in Electricity Loss Reduction in the Kyrgyz Republic. The objective of the subtask is to prepare an implementation plan and cost estimate for an immediate loss reduction demonstration program, comprising regulatory recommendations, public outreach

programs and demonstration projects for reducing technical and non-technical system losses (including technology and practices to improve metering, billing and collection).

Identified Demonstration Projects

Together with the JSC National Grid Company (the transmission company), JSC Severelektro (the distribution company servicing the town of Bishkek and Chui and Talas Oblasts), and JSC Oshelektro (the distribution company servicing Osh Oblast) three demonstration projects have been identified.

The demonstration projects will introduce technology and practices that have been recently successfully introduced in a few other regions of the former Soviet Union. Equipment specifications and operational practices will be developed together with the transmission and distribution companies and subsequently used for the preparation of loss reduction measures at a much larger scale under the above Government and World Bank supported programs. During the implementation of these programs the successfully introduced demonstration projects would be replicated.

Transmission demonstration project. A demonstration project at the high-voltage substation "Glavnaja" in the town of Bishkek was chosen to address the lack of metering at the delivery point between the transmission and distribution companies. Meters will be installed at all 220 kV, 110 kV, and 10 kV delivery points. Meters will be capable to communicate data to the office of the dispatch center where software will be installed to better balance supply and demand. The system will also support accurate accounting and improved billing of distribution companies for the provided electricity.

Distribution demonstration project. Demonstration projects have been identified in the towns of Bishkek and Osh. They are designed to address the shortcomings in three major areas of operations: internal distribution metering, end-user metering, and customer metering, billing and collection software. Meters will be installed at the delivery points feeding from 10 kV lines, at the 0.4 kV transformers and at end-user level. The demonstration projects target end-user metering at single family dwellings and apartment buildings and will cover approximately 1,000 consumers. The new meters will allow better monitoring of electricity flows to pinpoint losses with a target reduction of 50% of current losses in the demonstration area.

Next Steps

This report will be reviewed by USAID/CAR who will have approval authority for the implementation of the proposed demonstration projects. Assuming an early approval, implementation of the demonstration projects could start in November 2002. The implementation schedule would then be as follows:

- Signing of cooperation agreements — November 2002
- Preparation of detailed design and specifics: — November-December 2002
- Obtaining permits and approvals: — January-February 2003
- Procurement of equipment: — January-April 2003
- Procurement of installation company: — March-April 2003
- Training and installation: — May-August 2003

- Monitoring and evaluation: May 2003-April 2004
- Training and demonstrations: May 2003-April 2004

1. INTRODUCTION

1.1. Description of the Subtask

The strategy of the USAID Mission for Central Asia (USAID/CAR) is to support an improvement in the management of critical natural resources in the region through pilot projects to demonstrate good management and by training, public outreach and partnership development throughout the region. The strategy is being implemented by the Central Asia Natural Resource Management Program (NRMP).

The Transboundary Water and Energy Project (TWEP) under the NRMP supports activities that would help leaders in the Basin States develop and agree on solutions for the operation of the Toktogul Reservoir in the Kyrgyz Republic where a conflict has arisen between the energy needs of the Kyrgyz Republic and the irrigation needs of the downstream riparians. One of the options to mitigate this water/energy conflict is a reduction of the high energy losses in the Kyrgyz energy system during winter. A reduction of these losses to a reasonable level would lower the electricity demand from the Toktogul hydropower plant and four downstream hydropower plants, a system known as the Naryn Cascade. Also, increased revenue resulting from better metering, billing and collection practices could provide the financial means to the energy sector to improve existing thermal plants and pay for fuel.

The Government of the Kyrgyz Republic, concerned about the deteriorating situation of the electricity sector, has established a commission integrated by the National Grid Company (NGK), the State Energy Agency (SEA) and the four distribution companies tasked to define a "Plan of Measures to Stabilize the Situation of the Electricity Sector". The commission has recently prepared an extensive list of actions to be undertaken and assigned responsibilities to the various power sector players for their execution. This plan is described in Chapter 3 of this report and includes several actions designed to reduce electricity losses.

The magnitude of the electricity loss problem impacts the financial sustainability of the power supply industry and reducing this problem has been targeted as an objective of the World Bank (IBRD). Therefore IBRD as part of the monitoring of compliance on the terms of the Consolidated Structural Adjustment Credit (CSAC) offered by the International Development Association (IDA), is assisting distribution companies in implementing the actions mandated by the Electricity Sector Commission with funding from the CSAC. In addition, the World Bank and Government have agreed to allocate US$ 5 million from the remaining budget of the Power and District Heating Rehabilitation Project for equipment and materials to reduce electricity losses in the distribution systems.

Considering these initiatives, a subtask of TWEP was established for Support in Electricity Loss Reduction in the Kyrgyz Republic. The objective of the subtask is to prepare an implementation plan and cost estimate for an immediate loss reduction demonstration program comprising regulatory recommendations, public outreach programs and demonstration projects for reducing technical and non-technical system losses (including technology and practices to improve metering, billing and collection).

1.2. Organization of this Report

The report is organized in six chapters. Chapter 1 includes the introduction, origin and purpose of the task. Chapter 2 describes the characteristics of the Kyrgyz power sector from

a regional and historical perspective to provide a context for the problem of electricity losses. Chapter 3 presents a quantitative analysis of the problem of electricity losses, the related problems of billing and collection and a discussion of the institutional and regulatory aspects directly impacting the problem. Chapter 4 describes the proposed demonstration projects and discusses other actions recommended to complement the national loss reduction program. Chapter 5 summarizes the findings and recommendations of the mission. A list of useful references is included as Chapter 6.

A list of all organizations and persons contacted as part of this activity is included as Appendix A. An English translation of the Electricity Law of the Kyrgyz Republic enacted in January 23, 1997 is included as Appendix B. The current schedule of electricity tariffs is shown as Appendix C. Some photographs relevant to the proposed demonstration projects is included as Appendix D.

2. CHARACTERISTICS OF THE KYRGYZ POWER SECTOR

2.1. Historical Context of the Regional Management of Energy and Water

The Central Asian Republics (CARs) have large water and energy resources, but their distribution is highly skewed. The two largest rivers, the Amu Darya and Syr Darya, with an annual average flow of 116 km^3 originate in snowmelt and rainfall in the mountainous upstream countries of Tajikistan and the Kyrgyz Republic. The rivers then run for about 1,500 km through the arid plains of the downstream countries of Uzbekistan, Turkmenistan and Kazakhstan towards the Aral Sea. In terms of primary energy resources, Kazakhstan has significant reserves of hydrocarbons (oil, gas and gas) and coal; Uzbekistan has considerable amounts of gas and some oil and coal; whereas Turkmenistan has substantial reserves and production of natural gas. In contrast, the Kyrgyz Republic and Tajikistan have negligible amounts of commercially exploitable fossil fuels but enjoy generous water resources with abundant hydropower potential.

During the period 1960-1990, the Soviet system addressed these 'inequalities' created by nature through the development of an integrated water and power system. Most of the irrigated lands were developed in the downstream countries where natural conditions are more suitable for large-scale irrigated agriculture, particularly cotton. The largest storage reservoirs were constructed in the mountainous upstream countries to provide more regular water supply for irrigation and to generate hydropower. Water releases, and therefore hydroelectricity generation were highest during the summer growing season from April to September. An integrated 500 kV power system balanced the seasonal hydro energy with the output of thermal plants and the fuel needs of the Kyrgyz Republic and Tajikistan during the winter months were satisfied by oil and coal from Kazakhstan and natural gas from Uzbekistan and Turkmenistan.

After the break-up of the Soviet Union in 1991, the CARs acted expeditiously to adopt the water sharing arrangements that had prevailed during the Soviet era. In October 1991, the five Ministers in charge of water resources agreed to maintain the procedures, rules and limitations operational under the former Soviet system until new regional structures were developed. They signed, on 18 February 1992, an Agreement that established an Interstate Commission for Water Coordination (ICWC). The Heads of State of the five governments in March 1993 confirmed this agreement.

However, arrangements for the continued operation of the integrated water and power system soon came under stress given the new political and economic realities. Each of the States inherited the water and energy facilities on their own territory and understandably seek to promote their own interests and claim sovereignty over their sources within its own borders. While the underlying need to receive complementary resources (water to the downstream countries and fuel to the upstream countries) has remained, the resource ownership is now subject to sovereignty. The main transboundary water and energy issue that has emerged concerns the operation of the Toktogul Reservoir where a conflict has arisen between the winter energy needs of the Kyrgyz Republic, the irrigation needs of the downstream riparians, and the timing of environmental flows to the Aral Sea.

2.2. Characteristics of the Kyrgyz Power System

The power system of the Kyrgyz Republic was designed and developed as part of the Central Asia Interconnected Power System (UPSCAR) of the former Soviet Union. Until the break up of the Soviet Union one third of the demand in the northern region of Kyrgyz Republic was met by combined heat and power (CHP) plants in and around Bishkek and the rest was supplied by the Naryn cascade of hydroelectric power plants (HPP) and production from other resources of the interconnected system delivered through a 500 kV transmission line.

Generation System

Generation remains predominantly hydroelectric complemented with thermal power from two CHP plants. The CHP plants serve primarily industrial demands for heat and hot water and provide municipal district heating in the two main cities Bishkek and Osh. Table1 shows the capacity and production of generating plants in the Kyrgyz system.

Table 1. Generation of Kyrgyz Power Plants (2001)

Name of Plant	Installed Capacity (MW)	Production (Million KWh)	Commissioning Date
Toktogul HPP	1,200	4,787	1975
Kurpsay HPP	800	3,457	1982
Tashkymir HPP	450	2,006	1987
Shamaldisay HPP	240	915	1995
Uch-Kurgan HPP	180	973	1962
Atbashi HPP	40	150	1970
Small HPPs	40	50	1958
Bishkek CHP-1	678	1,166	1977
Osh CHP	50	49	1986
TOTAL Installed	3,678	13,553	

Transmission System

The high voltage network of the Kyrgyz Republic was designed as part of the Central Asia Interconnected System and configured to meet both regional and national transmission needs but is essentially a result of uneven distribution of load and generation resources. The bulk of generation is located in the southern part of the country while a very substantial portion of the load is in the northern region in and around Bishkek.

This and the mountainous nature of the terrain resulted in two well defined systems, north and south with a relatively weak link between them that must carry substantial flows of energy.

The key characteristics of transmission facilities are presented in Table 2

Table 2. Power Transmission Facilities in the Kyrgyz Republic

Voltage Level (kV)	Length of Lines (km)	Number of substations*
500	546	2
220	1,453	13
110	4,558	177

Note: Substations of power plants not included.

Distribution System

The distribution system of the Kyrgyz Republic includes all facilities at or below 35 kV. It includes overhead and cable lines of operating voltage 35kV, 10kV, 6kV and 0.4 kV, step-down substations 35kV-10/6 kV, distribution points 10/6 kV and distribution substation 10/6kV–0.4 kV. As a result of recent restructuring of the sector into separate generation, transmission and distribution companies, the separation points between high voltage and distribution networks are set at the beginning of the low voltage lines (35 kV, 10 kV and 6 kV) that feed from 110 kV and 220 kV substations. The total number of substations and length of the lines is provided in Table 3.

Table 3. Power Distribution Facilities in the Kyrgyz Republic

Voltage Level (kV)	Length of HVL (km)	Number of substations
35	4,318	325
10/6	26,959	19,048
0.4	27,940	-

Many adverse features of the distribution system of the Kyrgyz Republic are a direct consequence of the soviet approach to economics characterized by low capital cost allocation and a relatively higher allocation of cost to operation and maintenance. As a consequence the system includes extensive 6/10kV and 0.4 kV lines resulting in a design loss in the range of 11% against approximately 9% in a comparable western design.

This design characteristic leading to relatively high technical loss was accompanied by low construction quality leading to faster deterioration of structures, lines and substations. Based on the data provided by the State Energy Agency (SEA) 30% of distribution lines below 35kV are in need of rehabilitation. After a brief inspection of the networks it appears that a majority of infrastructure requiring rehabilitation needs to be entirely rebuilt.

The poor conditions of the distribution network have led to the deterioration of quality of service as reflected in the increasing number of service interruptions. The reported numbers of interruptions increased from 8,000 in 1999 to 13,000 in 2001. These numbers could be significantly higher as many interruptions are not being recorded.

2.3. Post-Independence Transition Issues

Since acquiring independence in 1991 the demand patterns and the fuel-energy balance of the Kyrgyz Republic have changed drastically.

Because of complications in intergovernmental relations and account settlements, introduction of national currencies, rising prices of oil, coal, natural gas and transportation, the supply of fuel and electricity to Kyrgyz from the other republics was reduced, radically affecting the Kyrgyz fuel-energy balance. In addition, the Kyrgyz economy went into a crisis triggered by the loss of a foreign market for most of its exports (sheep, cotton, fruit, vegetables, base metals etc) dropping by more than sixty percent the power demand for industrial and agriculture uses and leaving little foreign exchange to purchase fuel.

Without fuel the output of power and hence heat from CHP plants was halved giving rise to increased electric power demand by the population for heating, hot water supply and cooking. The drop in the demand of the industrial and agriculture sectors was more than

offset by rapid growth of residential demand. Since losses are higher in the residential sector this also contributed to a four-fold increase in losses from 11.5% in 1991 to 42.3% in 2001 as shown in Table 4.

Table 4. Demand by Consumer Group and System Losses (GWh)

Consumer Groups	1991	1996	1997	1998	1999	2000	2001
Industry	3,509	1,939	1,843	1,784	1,531	1,369	1,286
Commerce and budget	1,178	1,147	1,148	1,216	1,262	1,365	1,551
Agriculture	1,986	921	677	661	656	586	508
Residential	1,455	2,747	2,573	2,964	3,802	4,455	3,179
System losses	1,064	4,553	4,371	3,930	3,740	3,839	4,786
Internal demand	9,192	11,307	10,612	10,555	10,991	11,614	11,310

Source: SEA

The dramatic redistribution among consumer groups and the corresponding growth in losses within the last ten years is illustrated in Figure 4.

This redistribution of load partly caused by the shift in the residential use of energy from district heating to electrical heating resulted in a marked increase in the seasonal variation of the load. The result is in terms of current supply demand balance of electricity in the Kyrgyz Republic is presented in Figure 5 showing the sources and uses of electricity on a monthly basis.

Figure 4. Load Redistribution and Losses

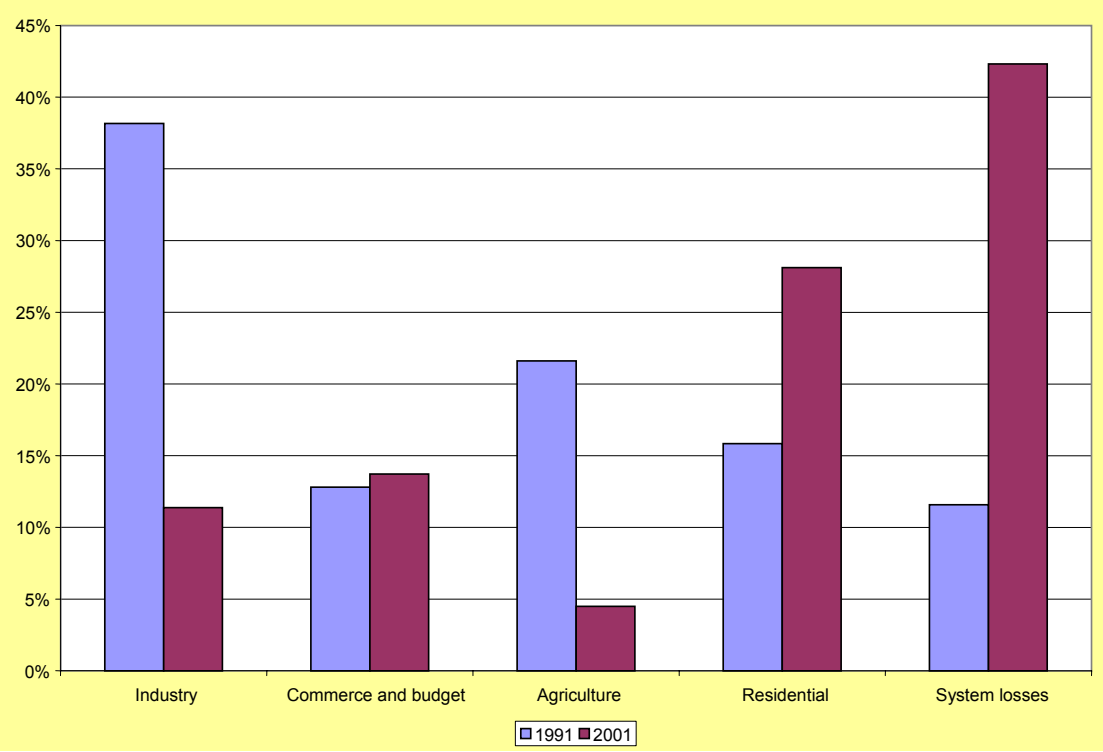


Figure 5. Monthly Power Supply and Demand Balance in 2001

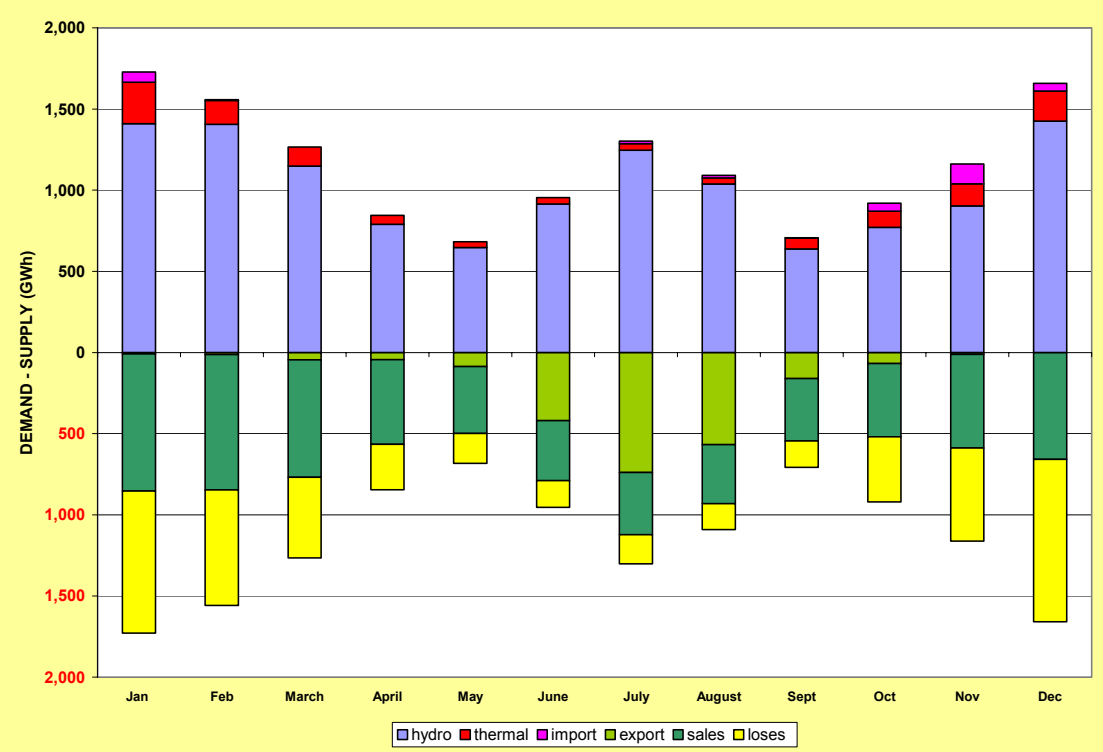


Figure 5 shows that there is a ratio of 3 to 1 between the month of highest demand (January) and that of lowest demand (May). Clearly such large variation places stress in a system with restricted capacity for investment as the facilities must be overloaded during certain times of the year. Figure 5 also shows that if losses could be substantially controlled the corresponding ratio could be close to 2 to 1.

In conclusion, the heavy dependence on hydroelectric power, the seasonally conflicting demands on the use of water for power and agriculture and the shift to a more seasonal demand pattern has had a detrimental effect on technical operations and the economic outlook of the sector. One of the most promising measures to rapidly mitigate this condition is to reduce the high level of losses.

2.4. Organization of the Power Sector

On January 23, 1997 the Legislative Assembly of the Jogorku Kenesh of the Kyrgyz Republic adopted a law to reorganize the sector by splitting the vertically integrated state monopoly Kyrgyzenergo into separate generation, transmission and distribution companies. This reorganization was undertaken to facilitate the more efficient management of the industry and the involvement of private capital.

Currently the sector is organized into several generation companies, one national grid company (NGK) and four distribution companies. The operation of the industry is controlled and regulated by the State Energy Agency (SEA). The NGK is responsible for the operation and maintenance of the transmission grid and for the economic dispatch of the system.

A discussion of institutional and regulatory aspects relevant to the problem of electricity losses is included in Chapter 3 of this report.

3. SOURCES OF SYSTEM LOSSES

In Chapter 2 it was shown that the total level of losses in the Kyrgyz system is approximately 42.3%, probably among the highest levels in any power system today. Lack of metering and other deficiencies that will be discussed in this report makes impossible a precise determination of how these losses are distributed, both along the various segments of the network and also in terms of their origin as technical or non-technical losses. However, in this chapter an attempt will be made to identify the most likely causes and estimate their contribution to the problem.

The power sector of the Kyrgyz Republic has only recently been restructured into separate generation, transmission and distribution companies and therefore statistics on the losses by each segment do not exist for previous years. For this reason we must analyze the problem on a system wide basis.

Design technical losses for a system like Kyrgyz would lie within the range of 12% to14% of the output from generating plants. Of these losses about 3% to 4% would correspond to the transmission network and 9% to10% would correspond to distribution. Any increase above such levels of technical losses can be attributed to inefficiencies derived from operational changes or equipment condition. The level of total losses of 11.5% recorded in 1991 is consistent with predominantly industrial load being carried substantially at the higher voltage levels but may have been slightly underestimated by metering deficiencies back then.

3.1. Transmission System Losses

Network Overload

The change in load distribution among consumer groups discussed in Chapter 2 affected the demand pattern not only in the time dimension but also geographically. While detailed data for parts of the system is not readily available it appears that the winter peak load in the northern region of the country has grown substantially. Combined with reduced production at Bishkek CHP due to scarce fuel this resulted in a higher burden on the 500 kV and 220 kV transmission link connecting the northern region with the more abundant generation to the south. Higher loads result in lower voltage and higher losses.

Existing Metering System

Since power supply was historically bundled within a vertically integrated structure metering was not originally designed to track power inflows and outflows for commercial purposes. Commercial metering existed only at end-users level. After the recent sector unbundling, the power generation stations, the transmission grid (NGK) and the four distribution companies began to operate more independently and there is a need to account for power deliveries from generation facilities into the transmission grid and from the grid to each individual distribution company and large industrial user. The metering system of the high voltage network is currently inadequate for this purpose.

The most serious deficiencies are found at the delivery points to distribution companies and large customers and most of the problems are related to inadequacy of current transformers

(CTs) and meters. There are certain accuracy requirements which CTs need to meet to be used in commercial metering systems. Usually errors should be under 0.5% or, in accordance with Russian standards, they should be of Class 0.5. However, since commercial metering was not required at many points which are now commercial points under the new structure, many existing CT's are of a type that have much lower accuracy with error levels of 3% to 10%.

The problem of meter accuracy is compounded by age and inadequate maintenance. All pre-independence meters are of outdated design, are not resistant to tampering and do not have the functionality of modern electronic meters to measure and record the flow of energy. Since the unbundling of JSC "Kyrgyzenergo", NGK initiated a meter installation and replacement project, beginning at the point of supply from generating plants. However, this initiative is being carried out with little consistency and different types of meters with different measurement and communication capabilities are used.

Anticipating Market Administration Needs

Metering at NGK will be essential for the implementation of wholesale market rules that are currently under consideration and therefore meters must take into account the features of that market. Some of the issues that need to be resolved before a widespread program of meter replacement is started are the following:

- What are the commodities to be traded at the wholesale market – energy only or energy and capacity? Is there a need for load profile measurement or maximum demand reading is sufficient?
- What kind of data acquisition system will be implemented by the market administrator and by the system operator and where should the information flow?
- What kind of communication means are available and will be used, so meters/modems would support such communication?
- What communication protocol is adopted?
- What is the required accuracy and what additional information is required for meters to provide such as reactive power, frequency and other technical quality parameters?
- Who is responsible for metering at the connection points to the high voltage network?

Metering System Optimization and Protection

At the same time it is still necessary to finalize the boundaries between the different companies to know exactly where the meters should be. NGK recently transferred facilities at 35 kV and lower voltage levels to the distribution companies. Once the boundaries are clearly defined metering points should be optimized so as to result in the least cost of meeting all metering requirements. This is an important cost issue since wholesale metering in this system can be implemented with anywhere between 400 to 2,500 meters. For example, currently commercial metering points are designated as those at the lines (feeders) going out from each 110/220 kV substation. The number of feeders varies from 10 to 40 per substation and thus the same number of meters is required. However, the same power going into the grid can be metered at the low voltage side of the transformers and usually only two meters per substation would be required.

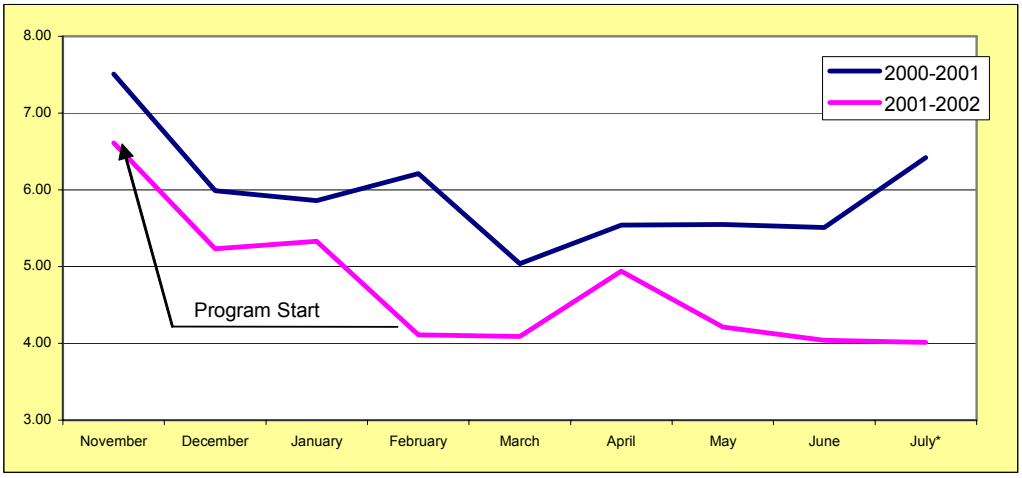
In addition to the above issues a critical matter to be addressed is the protection of the metering system from tampering and fraud. The very high level of losses in the transmission system can only be explained by widespread fraud at the delivery points and most likely at the connection with large users. The existing approach to metering, data gathering and reporting does not include cross-checks for internal control and therefore serious "leaks" and inconsistencies can go undetected.

Loss Reduction Targets

In recent years USAID provided assistance to implement a meter improvement program in the power system of Armenia of similar design and configuration as the Kyrgyz system (except for the 500 kV infrastructure at Kyrgyz). This program can be used as a measure of what can be reasonably expected from similar efforts in the Kyrgyz power sector.

Prior to implementation of new metering and data acquisition system the system transmission losses were 6% to 7% as calculated by different organizations. After implementation of a new metering system losses dropped to 4%. Figure 6 shows the rapid reduction of losses in Armenian transmission system through implementation of the metering program sponsored by USAID.

Figure 6. Loss Reduction in the Armenian Transmission System



Since 4% losses include consumption of substations and other ancillary services it is considered that this level is close to the technical losses in the system. Based on this experience it is a reasonable to expect that losses in the Kyrgyz transmission system could also be reduced to the level of technical losses in the range of 3% to 4% of power input to the grid.

In conclusion, the transmission system may have experienced some increase in technical losses due to a higher loading of the lines resulting from the seasonal redistribution of demand but a more serious problem appears to be the inaccuracy or lack of metering that could contribute to a sizable portion of non-technical losses at the transmission level. It is likely that transmission system losses are in the order of 7% as had been established in Armenia and approximately 3% of that would be in the form of non-technical losses due to fraud or inaccurate metering. This would leave approximately 35% of losses to the distribution system.

3.2. Distribution System Losses

Reallocation of Load by Voltage Level

The growth and redistribution of load during the last ten last years has had greater impact on the distribution system than on the transmission grid. Shifts in the share of load carried by different consumer groups resulted in changes in the allocation of load to networks of different voltage levels. Since technical losses increase in inverse proportion to the square of the voltage level the analysis of this reallocation is very relevant to understanding losses in the distribution system. An analysis of load by voltage level in the years1991 and 2001 has been carried out as part of this definitional study and is based on the following reasonable assumptions:

- Technical losses are assumed to remain at the level of 1991.
- The difference between total losses and technical losses for 2001 is assumed to be distributed as follows: Residential Users: 50%; Commercial and Institutional Users: 30%; Industrial Users: 10%; Agricultural Users: 10%.

Table 5 shows the distribution of load by consumer group and voltage level in 1991 and 2001. This distribution, applied to the actual demand levels by consumer group results in the distribution of load by voltage level shown in Figure 7.

Table 5. Reallocation of Demand by Consumer Group and Voltage Level

Category	35 kV		10/6 kV		0,4 kV	
	1991	2001	1991	2001	1991	2001
Industry	1/3	1/4	1/3	1/4	1/3	1/2
Commercial			1/3		2/3	1
Agriculture			1/3		2/3	1
Residential					1	1

Figure 7. Redistribution of Load by Voltage Level

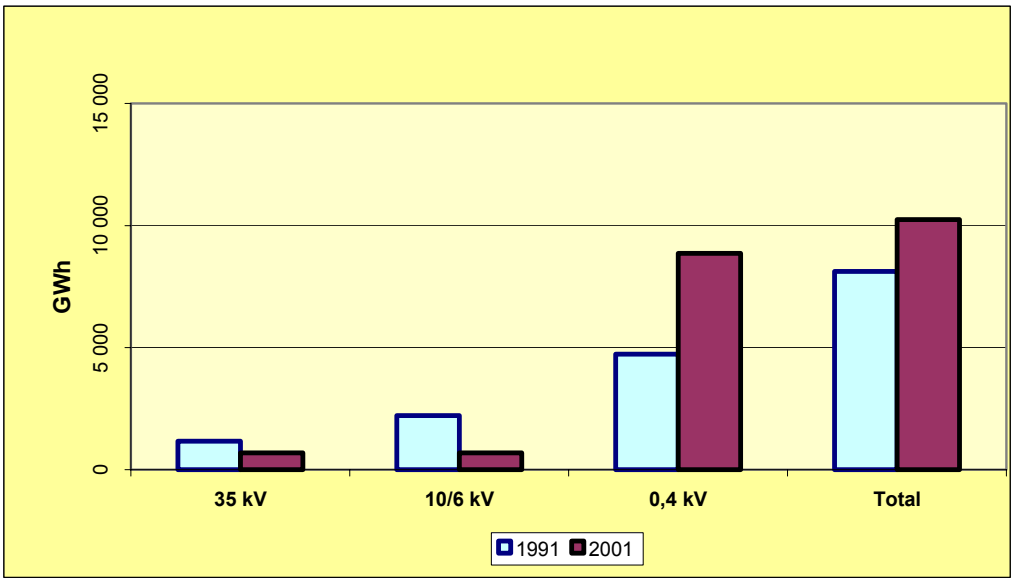
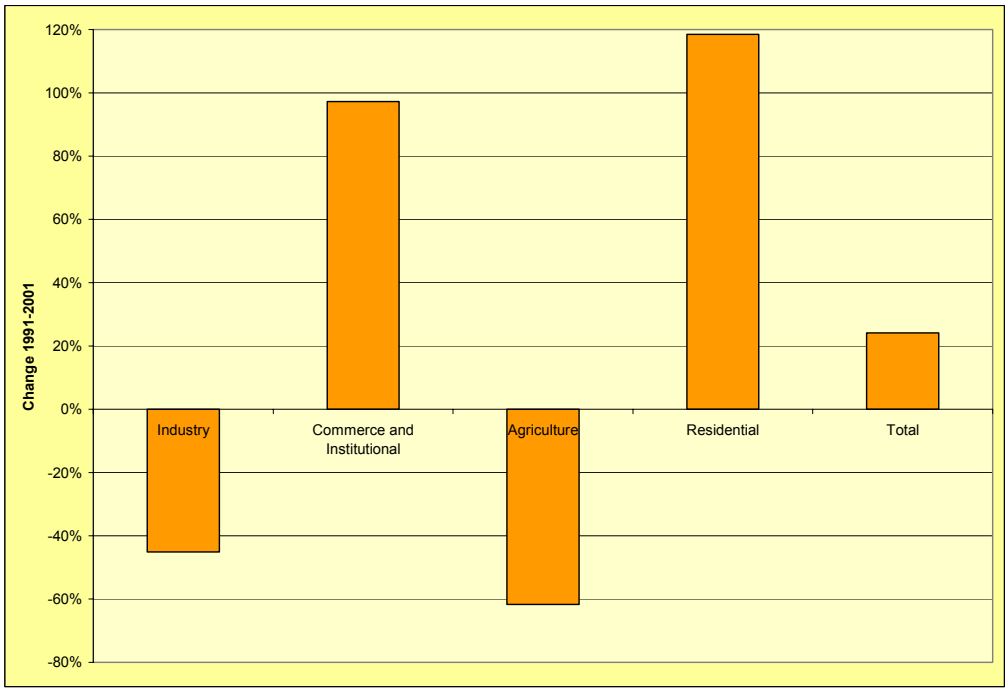


Figure 7 shows that substantial amounts of load that in 1991 were carried at 35 kV and 10/6 kV has shifted to the 0.4 kV networks, which are not designed to carry such burden. The shift resulted in severe overloads of distribution networks with increasing damages of transformer and line equipment and an exponential increase in technical losses. The theoretical redistribution of technical losses that can be expected from the historical redistribution of load by voltage level is shown in Figure 8 and it amounts to an increase of 24% of design losses for the system.

Figure 8. Change in Technical Losses through Voltage Redistribution



This phenomenon alone is causing significant financial losses to the sector through capital investment for rehabilitation and replacement of equipment and the increased operating costs of technical losses.

Thus, if total losses in the distribution system are in the order of 35% and technical losses could have increased from a design level of 10% to perhaps 13% due to overloading of lower voltage facilities, the rest, or about 22% is estimated to be due inaccurate metering and fraud.

Distribution System Metering

The distribution systems of all four companies suffer from a severe lack of metering capability, both due to the absence of meters at critical points as well as old and outdated equipment. The following problems were identified:

Insufficient metering. High voltage metering in distribution networks is only carried out at the delivery points, where distribution companies receive power from the transmission grid. The next level of downstream metering is at the end-users. There are no meters at intermediate points such as the terminals and feeders of 10/6 kV or at the incoming feeders of substations at 0.4 kV. This deficiency precludes tracking of power flows within the distribution system, which would help identify the source of losses and verify meter accuracy. Due to insufficient end-use metering, consumption figures for approximately 10%

to 15% of customers are estimated by the meter reader/controller based on the number of outlets and/or electrical appliances installed.

Unmetered Deliveries. It appears that unmetered energy is delivered to segments of the distribution network directly from some power plants, especially small hydroelectric plants. This fact could explain the low "apparent" level of distribution losses in the Jalal-Abad distribution company as unmetered power flows from hydroelectric plants located in company's service territory and contributes to increase the ratio between sales and metered deliveries.

Poor condition of existing meters. Many of the meters are well beyond their useful life, while others have suffered from inadequate maintenance. All existing meters are of outdated design and do not have the necessary functionality of modern electronic meters to measure and record the amount of received energy. Approximately 70% of end-user meters were built in the 1960s and some even earlier.

Meter fraud. Many apartments, commercial enterprises and single-family homes throughout the service territory of the distribution companies have inadequate and improper electrical installations, both primary and secondary wiring and meters. In addition to the serious threat to safety resulting from exposed wiring and unauthorized connections that use improper wiring the following abuses are widespread:

- By-passing of electrical meters through theft from the supply wires in the private houses and cables generally located in the basements of multi-floor buildings
- Tampering of unsecured meters that use old fashioned seals with no control capabilities
- Although some meters in multi-family buildings have been moved outside and sealed into metal boxes, the quality of the installation is not satisfactory and there is a risk that they could be tampered by trained electrical contractors.

Metering, Billing and Collection (MB&C) Database and Software

The metering, billing and collection (MB&C) software used in the distribution sector is outdated and does not meet basic requirements of commercial operations. The following problems were identified:

Operational and Commercial Data Consolidation The system does not allow tracking of network operations and thus precludes a consolidated database of operational and commercial data. This deficiency results in fragmented information that does not offer a consistent and verifiable picture of the operation of the distribution system.

Commercial Database Consolidation. Residential and non-residential databases are run separately, which further precludes tracking of power flow and deter theft at the low voltage balancing level.

Database Security. The MB&C software is not protected from unauthorized entry and it is open to intrusion by anyone with a basic knowledge of the system who could alter consumption data, financial information or even add or remove customer accounts.

Revenue Collection

More than twenty percent of all billings for power deliveries are not collected and the debt of the residential customer group has reached 847 million soms equivalent to US$ 18,5 million. Table 6 shows the distribution of metered consumption by customer groups and debt during the first six months of 2002.

Table 6. Consumption and Debt by Consumer Group (first half of 2002)

Distribution			Consumption		Debt	
	GWh	%	GWh	%	mln. Soms	%
Output to the network	5,090					
Losses, total	1,786	35%				
Technical	796	16%				
Non-technical	990	19%				
Totals			3,303	100%	1,580	100%
Industry			544	16%	186	12%
Commercial			446	14%	235	15%
Budget & Institutional			381	12%	117	7%
Agriculture			271	8%	195	12%
Residential			1,660	50%	847	54%

The problem of collection is related to legal, institutional and regulatory issues affecting the sector that will be explored in the next Section.

3.3. Legal, Institutional and Regulatory Aspects

It has been shown that the Kyrgyz power system has a high level of technical losses due to problems of configuration, design, construction and maintenance exacerbated by a rapid shift of the load profile. It has also been shown that both technical and non-technical losses are difficult to track due to insufficient and inaccurate metering.

While metering deficiency is a physical dimension of the problem of non-technical losses there is another dimension rooted in fundamental institutional, legal and regulatory weaknesses that for simplicity we may refer as "the political context" and which takes advantage of the physical deficiencies and contribute both to fraud and to the low rate of collection described above. The political context is far too complex for the mission to presume that in a few days it could get a full grasp of all or even its major components but in this report a few of the most visible issues will be described in terms of their relevance to the loss reduction effort.

Institutional Issues

The key components of the sector are the State Energy Agency (SEA), the generation companies, the National Grid of the Kyrgyz Republic (NGK) and the distribution companies. The definitional mission made the following observations regarding these institutions:

- SEA is a regulatory body with authority to enact rules but does not seem to be yet in a strong position to enforce them.

- NGK is the most visible remnant of the former JSC "Kyrgyzenergo" and is deeply concerned that a rapid pace of unbundling of the power industry could precipitate a crisis of supply.
- The generation and distribution companies are subjected to multiple and often conflicting instructions from local authorities, from the SEA, from other branches of government and from NGK. Since they are owned by the state they cannot ignore those instructions that conflict with official laws and regulations.

The sector is in the transition from total government control to a softly regulated industry driven by competition and market forces. However, so far only the segmentation of the industry has taken place which in effect only makes government control more difficult without yet any corresponding advantage of managerial or financial autonomy that could help resolve many of the problems.

Conflicting Authority

The legal basis for the organization and operation of the power sector is established in the Electricity Law of 1997 included as Appendix B. This law clearly assigns to the distribution companies the responsibility for collection of revenues. Revenue collection is a key provision that together with managerial autonomy and price caps (to be discussed later) should give distribution companies strong incentives to reduce losses.

However, in a recent proposal from the Ministry of Local Governance, it is suggested that distribution companies would transfer to local authorities the control over all commercial aspects including the right of local authorities to retain part of the revenue collected. This intrusion of local authorities on the electricity supply industry is probably a well intentioned if desperate effort to improve collection rates but it is in direct violation of the electricity law and illustrates the complex institutional framework faced by this young power sector where the lines of authority are blurred making it difficult to enforce laws and regulations.

Managerial Autonomy of the Distribution Companies

The unbundling of the vertically integrated JSC "Kyrgyzenergo" was the first step towards creating an environment that would promote efficient management, attract private investment and improve quality of service. Efficient management however requires tools such as the ability to reward good practices and discourage corruption.

The SEA agrees that without a means to reward efficient management it will be difficult to eliminate corruption but there is a perception that such autonomy cannot be achieved without privatization. Since privatization may be difficult before some improvement is achieved this view could unnecessarily help perpetuate the problem. Many countries have been able to introduce efficient management in state owned enterprises that were formerly riddled with inefficiency and corruption simply by allowing those enterprises to function as private companies.

A viable measure to provide incentives for efficient management would be to authorize distribution companies to allocate part of any improved collection as bonuses to their staff as part of a program to promote discipline in metering and eliminate corrupt practices. This concept is apparently feasible since the recent proposal discussed above would grant to the local authorities 10% of the reduction in receivables they could achieve. It is intriguing that

the reward is not direct to the management of the entities that under the law have the duty to collect.

Revenue Allocation

Despite the unbundling of the wholesale and retail activities there is not yet an unbundling of the revenue stream and all segments have to share tariff revenues without well established allocation criteria. Revenue from sales is held in trust by a bank, which is instructed by the SEA on the allocation of funds to distribution companies, the generating company and the NGK.

This modality effectively eliminates transfer prices from wholesale to retail segments and with them the need for distribution companies to responsibly account for the energy they receive wholesale. Thus, distribution companies are not financially liable to generation companies for the losses in their networks and instead the entire industry shares the shortfall in revenues.

Tariff Setting

According to Article 25 of the Electricity Law the SEA, at the request of the power companies prepares an updated rate schedule. The Electricity Law also establishes the principles for tariff determination which if applied would lead to a financially strong industry. However, the application of these principles is seriously limited by the provision that rates shall not cause sudden economic hardships to the consumers which takes rate review out of the sector and into the realm of politics.

The current rate schedule is unnecessarily complicated with 11 categories of customers mostly based on type of activity and most of which have a two-part (peak demand and energy) tariff. The rates, excluding value added tax, range from 0.43 som/kWh (0.93 US Cent/kWh) for residential customers under 150 kWh per month to 0.80 som/kWh (1.74 US Cents/kWh) and 45 Som/KW-month (0.98 US$/kW-month) for residential customers with high demand. Assuming a 70 percent load factor the highest rate paid is about 1.90 US Cent/kWh. The average is probably around 1.00 US cent/kWh. These rates, even with perfect collection, are unlikely to recover the full cost of the distribution system, let alone generation and transmission therefore the system is in a subsistence mode progressively deteriorating due to virtually no capital investment.

Winter heating provides a very compelling example of the economic distortions caused by the tariff system and compounded by widespread fraud. While public district heating is relatively inexpensive at the equivalent of 25 US$/month for a single family dwelling, many residential consumers prefer to have their district heating service cancelled and switch to electricity. At the average rate of 1.00 US Cent/kWh and assuming a winter consumption of 2,000 kWh per month this appears justified even by honest electricity customers since they can save about US$ 5 per month. However, the high seasonality of losses suggests that much of that fuel-switching is promoted by the fact that it is easier to hide electricity consumption than to hide illegal connections to district heating networks.

Barter System

From the point of view of loss reduction the problem is as much with the lack of financial resources but with the manner of the collection and allocation of sales revenues.

Approximately 60 percent of electricity revenues are collected in a complex barter system that includes international exchanges. This practice has a huge potential for unfair distribution of the cost burden and also for corrupt accounting siphoning much needed revenue out of a sector already suffering from grossly inadequate electricity tariffs.

Since the international agreements for the exchange of electricity and fuel are of a political nature there could well be no relationship between the actual energy exchanges and their market value. Thus, it is unclear whether the economic cost of summer water releases from Toktogul is compensated by the fuel received for winter generation at CHP plants or if the opportunity cost of that fuel to the downstream countries is equal to the economic benefits they receive.

Similarly, the value of goods received by distribution companies from large users in exchange of electricity may be difficult to establish and even more difficult to properly reflect in their books.

3.4. National Loss Reduction Program

It would be a gross omission of this report not to describe the efforts currently underway by the Kyrgyz government to help resolve many of the problems identified by the mission.

Concerned by the need to stabilize the situation of the electricity sector a number of measures have been mandated to various key players by a commission integrated by the NGK, the Distribution Companies and the SEA. Some of the measures are directly relevant to the loss reduction effort while others address some of the institutional aspects discussed above.

The following are among the measures that are directly related to the loss reduction effort:

- Implement accountability of energy balances by district branches of Distribution Companies.
- Replace overloaded transformer and increase conductor diameter in the 0.4 kV to 35 kV networks.
- Balance load among phases.
- Reduce technical losses in power plants and the transmission grid.
- Promote peak load shifting.
- Organize local production of electricity meters with adequate seals.
- Prepare schedule for the installation of new meters and to test and replace existing meters.
- Define customer categories subject to prepayment.
- Enhance administrative and criminal responsibility for electricity theft.
- Establish a standard loss reporting system.
- Adopt the same billing software used by JSC “Severelektro” in an effort to bring to 100 percent the billing of all metered consumption.

Other measures contemplated in the program that target the institutional and regulatory aspects are as follows:

- Improve qualification of distribution company staff and establish individual performance contracts.
- Eliminate barter operations and amend international agreements based on barter.

These measures should improve managerial efficiency and contribute to solve the problems of losses and collection. However, the measures need to be accompanied by identification of sources of funds, including rate increases, to implement them.

4. PROPOSED DEMONSTRATION PROJECTS

In order to assist the Government of the Kyrgyz Republic in its efforts to stabilize the situation of the power sector it is proposed to implement one transmission and two distribution loss reduction projects aimed at demonstrating the use of proven technology and practices.

These projects, which would be of a limited scale, would be designed to be replicable in many parts of the system leading to wide scale implementation after any adjustments to standards, rules and methods based on the findings during the demonstration phase.

The three proposed demonstration projects are described below.

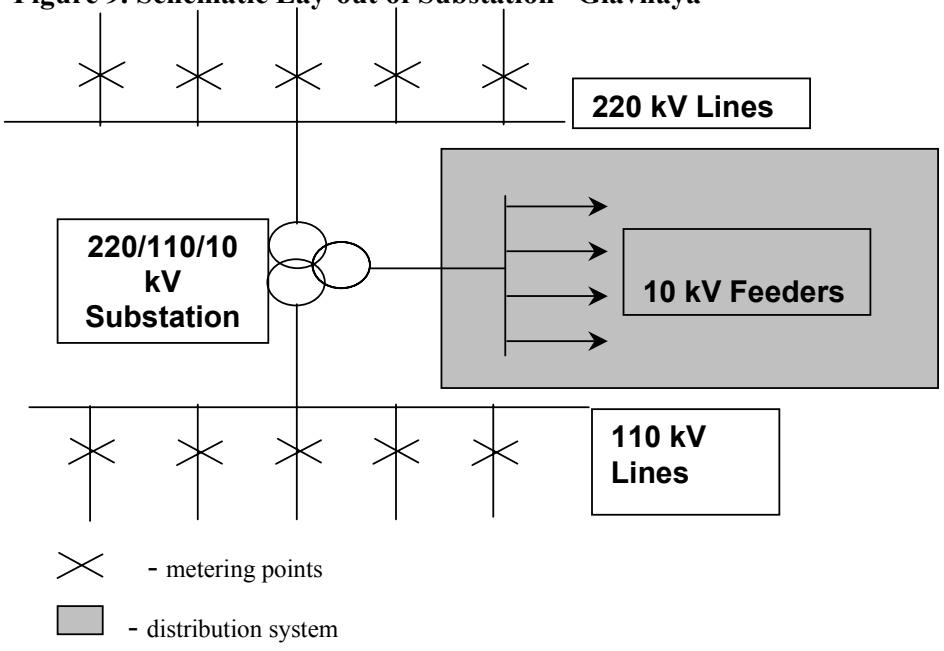
4.1. Transmission Demonstration Project

Description of the Project

The new unbundled wholesale power industry comprising the generation companies and the NGK lacks adequate metering at the borders between generation and transmission and transmission and distribution companies.

As a demonstration project for the transmission system (TDP) it is recommended to install a comprehensive metering system at a selected high voltage substation. The approach was discussed with the management of NGK and an agreement was reached to implement the proposed project at the 220/110/10 kV substation Glavnaja in the outskirts of Bishkek.

Figure 9. Schematic Lay-out of Substation "Glavnaya"



The proposed project includes procurement and installation of new electronic meters at all 110 kV and 220 kV feeders and 10 kV inputs. The meters contemplated for this project are of high accuracy, tamper resistant and with electronic memory recording. These meters will be capable to communicate information to the data acquisition center and the center will be equipped with special software to run calculations of power inflows and outflows and perform load balances at the substation level.

Expected Benefits

It is expected that this project will illustrate the merits of improved metering to track load flows and provide detailed data for commercial operation of the wholesale market. When replicated in other substations the project will lead to the following results:

- Improvement of the energy flow metering to support accurate accounting and clearing of all wholesale transactions enabling a smooth operation of the eventual market.
- Accurate, verifiable, tamper resistant and transparent data acquisition and processing which could be readily available to all authorized users.

These features are essential to seek the confidence of investors interested in the Kyrgyz power sector both at the generation and at the distribution level as the accounting of the flows of energy into and out of the grid is the heart of the operation of an unbundled power industry.

Detailed Scope and Budget

Based on the information provided by NGK there are 21 metering points as follows: 6 at 220 kV; 13 at 110 kV and 2 at 10 kV. The following activities are required to implement the TDP:

- Development of detailed project design including:
    - Verification of electrical scheme of substation;
    - Definition of metering points and number of required meters;
    - Development of the technical specifications of the meters for a wholesale metering system;
    - Development of the specifications for the metering data acquisition system and software.
- Acquire all required permits and approvals, including but not limited to:
    - Approval by SEA and NGK;
    - State standard approval;
    - Custom clearance, tax exemption, etc.
- Tendering and procurement of the equipment included into the approved design.
- One week training on equipment installation, operation and maintenance and integration of the data acquisition system.
- Installation oversight (it is expected that installation of equipment and integration of the system will be performed by NGK).
- Commissioning of the system.

Table 7 shows an estimate of the equipment and services required for the TDP.

Table 7. List of Equipment and Subcontract Services for Transmission Demonstration Project

Equipment	Unit	Unit price (US$)	Quantity*	Price* (US$)
Three phase meters	Meters	500	25	12,500
Laptop and reading interface	Units	2,000	1	2,000
Database software	Units	1,000	1	1,000
Modems	Units	100	2	200
Wires and ancillary	Units	500	1	500
Training	Session	2,500	1	2,500
Contingency 10%				1,870
TOTAL				20,570

Note: Quantity and Price numbers are indicative and will be finalized upon completion of the Project Design and competitive procurement.

4.2. Distribution Demonstration Projects

Project Description

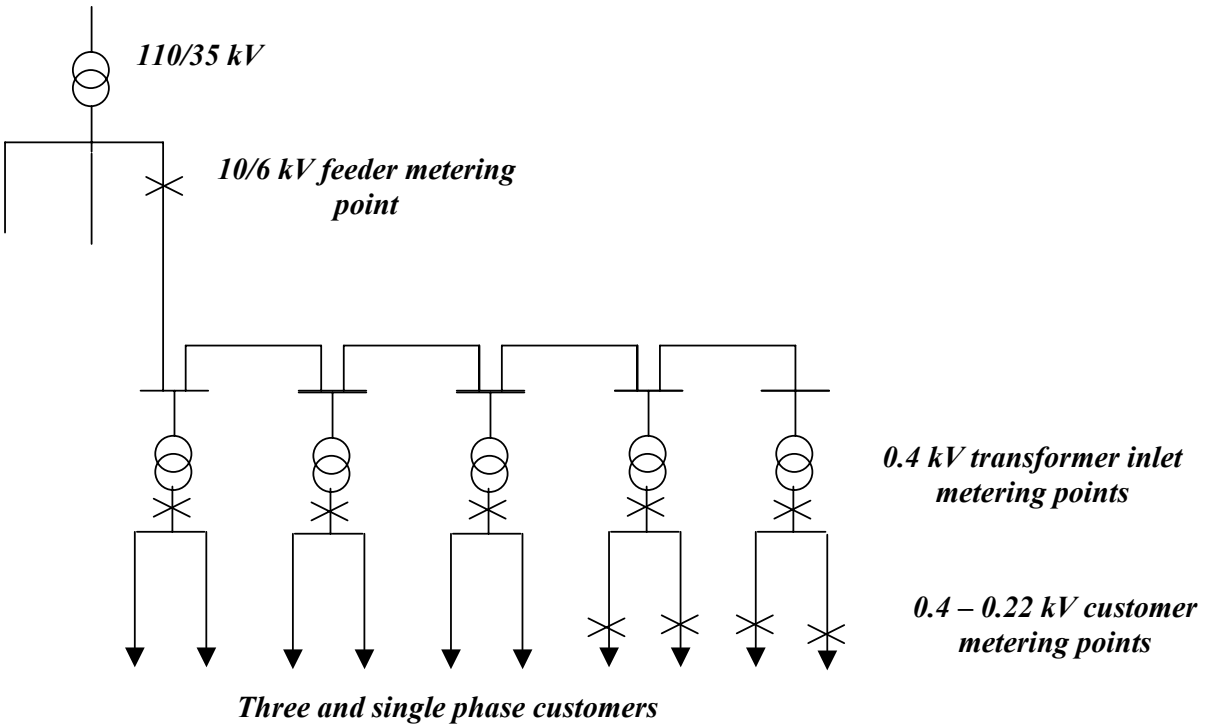
Currently distribution companies support metering at the end-users level only except for 10% to 15% of customers who have estimated consumption in lieu of meters. Internal metering at the substation inlet point is missing completely. This situation prevents tracking of power flows within the network and to detect inconsistencies and identify sources of losses. End-user metering is not adequate as meters are mainly installed inside customer premises and are vulnerable to tampering. Finally, the metering, billing and collection (MB&C) software does not support internal power balancing even if the information were available from meters.

Distribution demonstration projects (DDP's) are proposed at two distribution companies one at JSC “Severelektro” and another at JSC “Oshelektro”. In each case the distribution demonstration projects are designed to implement top-down metering at selected feeders from the distribution transformers to the end user (Figure 10) and the project would provide assistance to the utilities in the specification, procurement and implementation of metering, billing and collection software.

Expected Benefits

The improved metering configuration and associated software will allow distribution companies to balance and control power flows at the level 10/6 kV and 0.4 kV and between each 0.4 kV substation and its corresponding end users. This capability will protect the safety of customers while enabling the utilities to implement sound commercial practices, such as regular meter reading, accurate billing and disconnection and reconnection of service. The final result will be increased cash collections through reduced fraud and hopefully a higher level of customer satisfaction with the quality of the installation and confidence on the accuracy of metering.

Figure 10. Schematic Lay-out of the Distribution Demonstration Project



In addition these demonstration projects will be designed to help utilities compare the results of master metering with and without complete end-user re-metering. If master metering alone can improve loss reduction and cash collection substantially this approach can be used as a first step in other parts of the distribution system.

Detailed Scope and Budget

The overall approach top the demonstration projects has been agreed with the management of each distribution company and initial selection of the substations and feeders were made. The locations and number of customers were defined under the assumption that approximately US$ 220,000 funding would be available. If, however, the available funding were lower adjustments can be made to reduce the number of customers affected by the DDP.

On this basis the following improvements are planned:

- Installation of tamper resistant, electronic meters at the 10/6 kV metering points.
- Installation of tamper resistant, electronic meters at the 0.4 kV inlet metering points of all transformers.
- Remetering/renovation of the meter installations of all customers supplied from 0.4 kV transformers. End-user remetering/renovation project at single-family and multi- family dwellings will include the following upgrades:
    - Relocate meters into locked boxes that permits reading through a clear panel and enables disconnection while preventing unauthorized access and tampering;

    - Rewire essential circuits in accordance with standards of safety and operability;
    - Remove unauthorized connections and wiring;
    - Relocate supply cables at the basement of multi-family buildings to the front of the building.
- Installation of individually numbered and tamper resistant meter seals at all metering points included in the demonstration project.
- Assistance to specify and procure basic software to support MB&C operations to be programmed by utility staff or local contractors.
- Procurement of basic hardware, such as servers and other IT equipment, to support MB&C operations.

To carry out the project the following activities are proposed in each of the two Distribution Demonstration Projects:

- Development of detailed project design, which includes:
    - Verification of electrical scheme of distribution network;
    - Definition of metering points, number and type of customers and meters;
    - Development of design of meter enclosures;
    - Development of the technical specifications of the single phase, three-phase substation and customer meters;
    - Development of the specifications for the MB&C software and hardware.
- Acquire all required permits and approvals, including but not limited to:
    - Approval by SEA and company;
    - State standard approval;
    - Custom clearance and tax exemption, etc.
- Tendering and procurement of the equipment included into the approved design.
- Tendering and contracting of meter enclosure production.
- Tendering and contracting of installation services to the local service providers.
- One week training on equipment installation, operation and maintenance (it is assumed that the same vendor would procure the meters and thus one session training will be provided to transmission and distribution personnel).
- Installation oversight.
- Commissioning of the system.

Tables 8 and 9 show the estimated cost of equipment and subcontracted services to implement the DDP at JSC “Oshelektro” and JSC “Severelektro” respectively.

Table 8. List of Equipment and Subcontract Services for Distribution Demonstration Project – JSC "Oshelektro"

Equipment	Unit	Unit price (US$)	Quantity*	Price* (US$)
Single phase meters	Unit	35	400	14,000
Three phase meters	Unit	200	80	16,000
Boxes	$/customer	25	480	12,000
CTs	CTs	10	240	2,400
Seals	Units	0.15	5000	750
Cables, wires	Meter	5	2000	10,000
Installation services	$/project	15,000	1	15,000
Server	Unit	10,000	1	10,000
Workstations	Unit	1,000	2	2,000
Laptop and interface	Unit	2,000	1	2,000
Printers	Unit	500	2	1,000
Modems	Unit	100	5	500
Ancillary IT equipment	Unit	1,000	1	1,000
Contingency - 10%				8,665
TOTAL				95,315

Note: Quantity and Price numbers are indicative and will be finalized upon completion of the Project Design and competitive procurement.

Table 9. List of Equipment and Subcontract Services for Distribution Demonstration Project – JSC "Severelektro"

Equipment	Unit	Unit price (US$)	Quantity*	Price* (US$)
Single phase meters	Unit	35	500	17,500
Three phase meters	Unit	200	80	16,000
Boxes	$/customer	25	550	13,750
CTs	CTs	10	150	1,500
Seals	Unit	0.15	5000	750
Cables, wires	Meter	5	2000	10,000
Installation services	$/project	15,000	1	15,000
Server	Unit	15,000	1	15,000
Workstations	Unit	1,000	2	2,000
Laptop and interface	Unit	2,000	1	2,000
Printers	Unit	500	2	1,000
Modems	Unit	100	2	200
Ancillary IT equipment	Unit	1000	1	1,000
Contingency - 10%				9,570
TOTAL				105,270

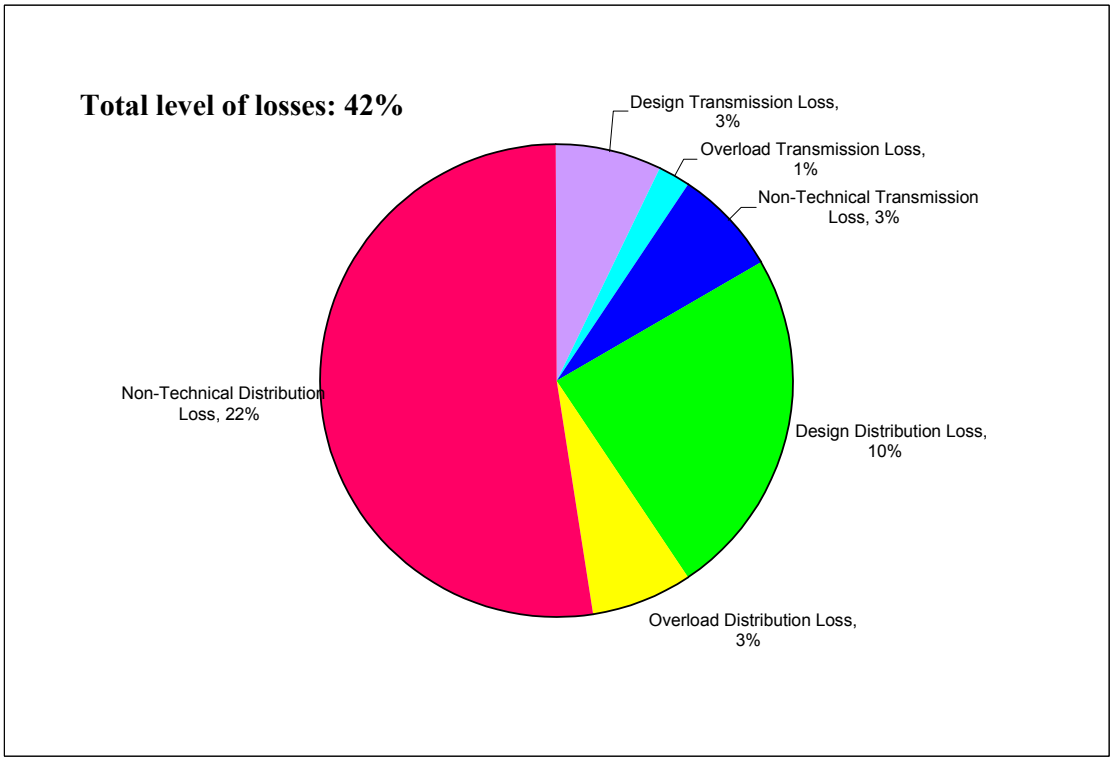
Note: Quantity and Price numbers are indicative and will be finalized upon completion of the Project Design and competitive procurement.

5. FINDINGS AND RECOMMENDATIONS

Based on the analysis described in this report it can be concluded that the Kyrgyz power system has serious problems that include technical, institutional, regulatory and managerial issues. Deficient metering, billing and collection coupled with low tariffs results in an excess of electricity demand taxing the already deteriorated infrastructure and displacing more traditional energy resources for heating, hot water and cooking. This in turn is exacerbating conflicts in the regional management of energy and water resources.

The most pressing problem is that of reduction and prevention of losses which have reached a staggering 42% of the power production and import. The estimated sources of losses are illustrated in Figure 11.

Figure 11. Estimated Sources of Losses



About 13% losses correspond to the normal technical losses that can be expected by design and of these 3% could be attributed to transmission and 10% to distribution. An additional 4% is estimated to correspond to the increase in technical losses resulting from a redistribution of demand among consumers that causes overloads in the system and also routes more power through the lower voltage segments of the network. The rest, or about, 26% is attributed to inaccurate metering and fraud resulting from a number of serious deficiencies in the metering system and associated commercial operations software that prevent load tracking to pinpoint losses and makes the system vulnerable to fraud.

The Government of the Kyrgyz Republic is aware of the problem and the path to its solution as evidenced by the recent measures that have been identified to stabilize the situation in the sector. However, the magnitude and complexity of the problem is such that it would be very difficult for a young institutional structure as has been recently implanted to implement the

solution with the necessary expediency without outside help from organizations that have had the benefit of prior experience in similar situations.

To assist the Government of the Kyrgyz Republic in this difficult task it is proposed that USAID provides funding for three demonstration projects, one focused on the transmission system and the other two in the distribution systems of the cities of Bishkek (Severelektro distribution company) and Osh (Oshelektro distribution company).

The projects, agreed in principle with the transmission and distribution companies, aim to replace the metering system in selected locations with modern, tamper resistant and accurate equipment and to implement state-of-the-art metering, billing and collection software. With these capabilities the utilities will be able to accurately track load flows and identify the source of losses to immediately take steps to eliminate them. The objective is to show that investments in metering can be promptly recovered through increased revenue, thus contributing to a sustainable improvement in the sector's financial performance. This effort can be complemented with public outreach programs and assistance to the SEA on regulatory actions to provide strong incentives for efficient management.

6. REFERENCES

1. Energy Research Institute of Russian Academy of Science, *Rational and efficient utilization of energy resources in Central Asia*, SPECA 2002.
2. ESB International, *Recommended specification to develop settlement system with the customers of JSC "Kyrgyzenergo*", May 2000.
3. Hagler *Bailly*, *Metering and billing status in electric utility sector in Kyrgyzstan – Analysis and Recommendations,* December 1997.
4. Hagler Bailly, *Order on curtailment and disconnection of electrical energy, thermal energy, and gas supply to consumers*, June 1998.
5. Hagler *Bailly*, *Temporary rules on curtailment and disconnections of electric energy, thermal energy, and gas supply to consumers under shortage of energy resources*, June 1998.
6. Hagler Bailly, *Time-of-Use rates and metering – Cost and Implementation issues*, February 1998.
7. PA Consulting Group, *Transboundary water and related energy cooperation for the Aral sea basin region of Central Asia – Phase I*, May 2002.
8. Price Waterhouse Coopers, *Audit of billing system – Final report*, February 2002
9. State Energy Agency, *National Grid Code*, 2002.
10. World Bank, *Aide Memoire of Supervision mission on Consolidated Structural Adjustment Credit (SCAC)*, December 2001.
11. World Bank, *Kyrgyz Republic: Energy Sector Review*, May 1995.

APPENDIX A. LIST OF MEETINGS

Organization	Name	Position and Contact Information	Time of the meeting
State Energy Agency	U. Mateev	Director	August 7, 21
State Energy Inspection	V. Shapar	First Deputy General Director, JSC "Power Stations"	August 7
Science Technical Center "Energiya"	Sh. Dikambaev	Director	August 7
	Yu. Simakov	Head of high-voltage laboratory	August 7
JSC "Severelectro"	Dj. Arystanov	First Deputy Director	August 8, 9, 22
	G. Demchenko	Head of Sales Department	August 8, 9, 22, 28
	V. Logachev	Head of Dispatch Center	August 8, 9
	B. Ibraimov	Head of Sales Department, Sokuluk branch	August 9
	O. Majitova	Engineer of Sales Department	August 8, 9, 22, 28
	E. Likhacheva	Programmer of Sales Department	August 9, 22, 28
	T. Kerimkulova	Head of Sales Department, Bishkek branch	August 22, 23, 28
	T. Ibraev	Sr. inspector of Sales Department, Bishkek branch	August 23, 24, 28
	O. Salihova	Sr. engineer of Sales Department, Bishkek Branch	August 23, 24
	T. Musuraliev	Engineer of Sales Department, Bishkek branch	August 23, 24
	A. Aydaraliev	Engineer of Sales Department, Bishkek branch	August 23, 24

JSC “Oshelectro”	M. Alymkulov	General Director	August 19
	A. Attokurov	First Deputy Director	August 19, 20
	M. Fattakhov	Technical Deputy Director	August 19, 20
	A. Buslaev	Head of Technical Department	August 19, 20
	A. Suldin	Head of Metering Department	August 19, 20
	K. Chymynov	Head of Sales Department, Osh branch	August 19, 20
	B. Israilov	Sr. engineer, Osh branch	August 20
	A. Artykov	Engineer, Osh branch	August 20
JSC ”National Grid of Kyrgyzstan”	I. Davydov	First Deputy Director	August 15
	M. Iminov	Head of Technical Center	August 16, 29
World Bank	N. Charkova	Program Officer	August 14

APPENDIX B. ELECTRICITY LAW OF THE KYRGYZ REPUBLIC

Adopted by the Legislative Assembly of the Jogorku Kenesh of the Kyrgyz Republic on January 23, 1997

The present Law is based on provisions of the Energy Law of the Kyrgyz Republic and other legislation of the Kyrgyz Republic and applies to all legal entities regardless of the form of ownership and individuals that generate, transmit, distribute, sell or consume electricity and thermal energy.

Article 1: Objectives of the Law

This law is aimed at assuring reliable, safe and uninterrupted supply of electricity and thermal energy and at improving the quality of service to all consumers, creating a competitive environment and energy market, encouraging development of the private sector and attracting investments.

Article 2: Definitions

As used in the Law, the meaning of the terms listed below shall be interpreted as follows:

Generation of electricity and thermal energy - The production of electricity and thermal energy from energy resources.

Generator - Any state, private legal entity or individual which operates a Power Plant and generates electricity.

Hydro-Electric Station - Any station for the generation of electricity by use of the energy of the water and hydrotechnical constructions and equipment associated with such generation.

Integrated Enterprise - Any state or private enterprise performing two or more of the activities of generation, transmission, distribution and sale of electricity and thermal energy.

National Grid - The system of means for transmitting high voltage electricity.

National Energy System - A complex of existing Power Plants, Hydro-Electric Stations, electric (including National Grid) and district heating network tied together by an integral operational regime under centralized management, carried out by the dispatcher service.

Interconnected Systems - A number of transmission and distribution systems linked together by means of one or more systems.

Electricity for Own Needs - Electricity generated by any state, private legal entity or individual for its own consumption.

Major Consumer - A purchaser of electricity from High Voltage Network directly from a Generator.

Transmission - The movement of high voltage electricity on the National Grid for delivery to Major Consumers or Distributors.

Transporter - Any state, private legal entity or individual which transmits electricity between the Delivery Point of the Generator and the point of reception by the Distributor or the Major Consumer.

Captive Customer - An end-use consumer who is supplied exclusively by one Distributor with low voltage electricity and thermal energy.

Electricity Distribution Network - The electricity-conducting system, including the support structures together with associated constructions and equipment, used to distribute electricity and send it to the Connection Point.

Distributor - Any state, private legal entity or individual which supplies electricity or thermal energy to Consumers within a specified territory.

High Voltage Networks - Electricity networks and substations with a voltage of 35 kV and higher.

Standard Contract on Supply of Electricity - A defined list of rights and obligations of Generators, Transporters, Distributors and Consumers that constitutes a contract to which each agrees to abide by providing or receiving service.

Connection Point - The boundary of property between a Distributor of electricity and thermal energy and a consumer or between a Transporter and Distributor or a Major Consumer.

Delivery Point - The boundary of property between a Generator and a Transporter or between a Transporter and a Distributor of electricity and thermal energy or a Major Consumer.

Installation - Apparatus designed for the generation, transmission, distribution of electricity and thermal energy, including equipment, buildings and lands used in connection therewith.

Electricity Sector - The structure of the state and non-state enterprises involved in the generation, transmission, distribution or sale of electricity or thermal energy.

Power Plant - Any station for generation of electricity or thermal energy by using any energy resources.

Electric/Thermal Enterprise - Any state, private legal entity or individual engaged in the generation, transmission, distribution or selling of electricity or thermal energy regardless of the form of ownership.

Theft of Electricity or Thermal Energy - Unauthorized connection, consumption and delivery of electricity or thermal energy without proper permission.

Article 3: Separation of Function

The Assemblies of the Jogorku Kenesh shall approve the Program of Denationalization and Privatization of the Electricity Sector and also approve the National Energy Program upon submission by the Government of the Kyrgyz Republic.

The Government of the Kyrgyz Republic shall define policy for the Electricity Sector and implement it in accord with the approved National Energy Program.

The State Energy Agency under the Government of the Kyrgyz Republic shall balance the interests of the producers and consumers of electricity and thermal energy, and the local population in the areas of construction of hydro power stations.

All state and non-state legal entities and individuals that generate, transmit, distribute or sell electricity and thermal energy will be responsible for safe, reliable and efficient operation and management of their enterprises.

Article 4: State Regulation of the Electricity Sector

State regulation of the Electricity Sector shall be carried out to provide electricity and thermal energy throughout the Republic at economically justified, socially affordable and non-discriminatory prices, as well as to control for the provision of reliable, safe and uninterrupted generation and consumption of electricity and thermal energy.

Article 5: General Provisions for Licensing

No state, non-state legal, private entity or individual is authorized to engage in the generation, transmission, distribution or sale of electricity or thermal energy unless it has obtained a License issued by the State Energy Agency under the Government of the Kyrgyz Republic, except those who are subject to Article 12 of this Law.

Procedures and conditions for issuing licenses as well as the duration and form of the licenses for Electric Enterprises shall be determined in accord with the provisions of the present Law and other legislation of the Kyrgyz Republic.

Decisions on issuing a license or on refusing to issue it shall be made within 30 days after receiving an application with all required documents.

Licenses shall be issued on a fee basis. The size of the fee for consideration of the application, necessary examination and issuance of the license will be based on the corresponding expenses of the State Energy Agency under the Government of the Kyrgyz Republic. Procedures for determining the fee shall be specified in the provisions on licensing specific types of activities, which will be approved by the Government of the Kyrgyz Republic.

Integrated Enterprises shall obtain licenses separately for each type of activity - generation, transmission, distribution and sale of electricity and thermal energy.

Article 6: Revocation, Suspension or Modification of the License

The State Energy Agency under the Government of the Kyrgyz Republic has the right to revoke a License or impose a fine if the License Holder:

- violates the conditions of the License or legislation of the Kyrgyz Republic;
- operates in a manner that endangers the life and safety of the people;
- violates conditions on environmental protection.

The State Energy Agency under the Government of the Kyrgyz Republic cannot revoke or suspend a License or modify the conditions contained in the License without prior notice sent to the License Holder by the Agency in accord with procedures and the conditions set forth in

the License. The License Holder has the right to appeal the decision to revoke or suspend the license to the court.

The License Holder may request a modification to the content of the License in the case of a substantial change in circumstances that affects the ability of the License Holder to meet the conditions of the License.

Article 7: Review of License

License Holders do not have the right to transfer or sell their licenses. A change of structure or ownership of a License Holder through acquisition, merger, sale, separation, division or divestiture shall require review and modification of the conditions of the License.

Article 8: Rules on Generation Licenses

No Generator will be granted exclusive or monopoly rights under the legislation of the Kyrgyz Republic. Energy Enterprises can sell electric or thermal energy that they generate to the National Grid, Distributors or Major Consumers. The market is open to all businessmen provided that they comply with the licensing requirements, provisions of the National Energy Program, and legislation of the Kyrgyz Republic.

Generation Licenses shall specify the conditions for the use of the resources involved in the generation of electric or thermal energy, the limitations of the rights of the Generator, and such other conditions as are appropriate.

Article 9: New Generation Capacities

Any proposal for the construction of new generating capacity shall be made in accord with the National Energy Program and executed under the conditions established in Article 19 and 20 of this Law.

Issuance of licenses for the construction of Power Plants and High Voltage Networks is carried out by the State Energy Agency under the Government of the Kyrgyz Republic. The construction of a Power Plant or a High Voltage Network of 220 kV or higher must be approved by the Government of the Kyrgyz Republic. Work permits for the construction of Distribution Networks is carried out by the Local Authorities upon agreement with Distributors. Construction of Power Plants and High Voltage Network and Distribution Network can be carried out by people who have appropriate licenses for this type of activities.

Article 10: Hydro Electric Stations

The issuance of any License related to hydro electric generation must be subject to a prior study concerning the impact on the use of water for purposes other than electric generation. The results of that study must be transmitted for information to the Local Authorities of the territory in which the Hydro-Electric Station will be constructed or will have effects.

It is compulsory that any call for tenders relating to a Hydro Electric Station, either for the extension of existing power capacities or for the construction of new power capacities, shall contain a memorandum on such study and its results.

All expenses and losses incurred by the local population as the result of construction of a Hydro Electric Station shall be included in the cost estimate of the construction.

Article 11: Nuclear Plants

The construction of any nuclear power plant must be authorized by the Legislative Assembly and the Assembly of People's Representative of the Jogorku Kenesh of the Kyrgyz Republic.

Article 12: Generation of Electricity for Own Needs

No Generation License shall be required for any legal entity or individual wishing to generate electricity for its own use. With capacity of 1000 kW or more, they must obtain permissions from the State Energy Agency under the Government of the Kyrgyz Republic and local authorities in accord with legislation of the Kyrgyz Republic.

Legal entities or individuals generating electricity for their own needs are forbidden to connect to the National Grid and to sell electricity to third parties without the appropriate authorization.

Article 13: Maintenance and Operation of the National Grid

The State Energy Agency under the Government of the Kyrgyz Republic shall issue a license for transmission of electricity through the National Grid, which functions for the duration of the valid license as an integrated system dispatched under the control of the Holder of Transmission License. Issuance of the License must be approved by the Government of the Kyrgyz Republic.

The Holder of Transmission License does not have any monopoly on sectors or geographic areas, other than related to the maintenance and management of the National Grid.

The Holder of Transmission License has the duty to carry out the dispatch of electricity in an economically efficient way, as well as to operate and maintain the National Grid and Interconnected Energy Systems in accord with legislation of the Kyrgyz Republic and the National Energy Program.

The Holder of Transmission License through the National Grid can not restrict access to the National Grid, or impose unreasonable requirements on users of or sellers to the National Grid. However, under emergency circumstances, the Holder of Transmission License through the National Grid may take any action necessary to ensure the safety of people or assets and the continuity of supply of electricity.

Article 14: The Obligation of Distributors

Holders of Distribution Licenses are obligated to supply electricity to all customers who request service within the territory of their operations, including supply of electricity to clients in remote areas.

Distributors are obliged to reimburse customers within 6 months for expenses on purchasing materials, installation and repairs of energy equipment which is the property of the Distributor.

Distributors are obliged to indemnify the customers for the damage caused by disconnection of electricity without prior notice and by supply of electricity that does not meet the State Standards.

Article 15: Standard Contract on Supply of Electricity

The State Energy Agency under the Government of the Kyrgyz Republic will establish a Standard Contract on Supply of Electricity that will govern the rights and obligations of Distributors and consumers. None of the provisions of this Standard Contract can be changed by either party to the contract. However, Distributors may propose that the State Energy Agency under the Government of the Kyrgyz Republic consider additional conditions on rights and obligations that do not conflict with the purpose and wording of the Standard Contract on Supply of Electricity.

Standard Contract on Supply of Electricity shall be approved by the Government of the Kyrgyz Republic.

Article 16: Compliance with Main Principles of Operation

- Distributors will carry out their activities in accordance with the following principles:
- Maintain a safe, reliable and uninterrupted supply of electricity;
- Adopt such management practices that result in continual improvements in productivity and efficiency;
- Show respect for the interests and needs of consumers, including matters of their safety;
- Provide continual improvements in quality of service to consumers at fair prices;
- Take prompt measures on consumer complaints;
- Do not damage the environment.

Article 17: Distributors Right to Interrupt Service

If a consumer does not pay within the time period set forth in the supply contract, the Distributor may disconnect the consumer under conditions and procedures set forth in the supply contract, except those cases when disconnection would result in a threat to life, health or safety of the people.

Electricity supply for an uninterrupted industrial process shall be interrupted in accord with conditions and procedures which ensure completion of technological cycle of production.

The bills of Captive Customers who are unable to pay for service provided may be settled through the mechanisms provided for in Article 22 of this Law.

Consumers have the right to submit their complaints to the State Energy Agency under the Government of the Kyrgyz Republic or to the court if an interruption in supply of electricity or thermal energy or worsening of the quality of supply takes place because of the supplier's fault.

Article 18: Sale of Electricity

Any state, private entity or individual engaging in the import, export or sale of electricity is required to obtain a License from the State Energy Agency under the Government of the Kyrgyz Republic.

Article 19: Call for Tenders

The competent government entity will call for international tenders for the construction of Power Installations, generation, transmission, or distribution of electricity and thermal energy.

Article 20: Tender Procedure

Details of the tender procedure and the criteria for the selection of bids and identification of the winner will be set forth in a Decree of the Government of the Kyrgyz Republic and shall be published in the Official Gazettes.

Article 21: Tariffs

The State Energy Agency under the Government of the Kyrgyz Republic shall establish tariffs in accord with the following principles:

- Prices should reflect the full cost of the generation, transmission and distribution of electric or thermal energy, including operating and maintenance costs, the recovery of the capital invested, the costs of borrowing funds and interest rate of return;
- Changes in prices should not cause sudden economic hardship to either consumers or producers;
- Discrimination in tariffs and provision of service, including quality of service, is prohibited;
- All consumers within the same group and with the same characteristics of consumption and served by the same Distributor shall receive the same tariffs and service;
- Tariffs for each group of energy consumers shall reflect full cost of providing service;
- Subsidies from one group of consumer to another are prohibited;
- Tariffs should be established to reflect the difference in the cost of providing service in different seasons and at different times of the day, as well as the different types of services or services of a different quality, so customers have the ability to choose.

Article 22: Provision of Service to Low Income Consumers

The Government of the Kyrgyz Republic, Oblast, Rayon and City State Administrations, and the Bishkek City Administration may provide direct subsidies exclusively to pay for a determined amount of energy consumed by Captive Customers who are unable to pay the full cost of electric or thermal energy.

Article 23: Metering, Billing and Collection

Every Distributor is required to install reliable and secure meters at every point of service delivery, to regularly read the meters, to bill, and to institute effective methods of collection.

Article 24: Remedies for Theft

For the theft of electrical or thermal energy, tampering with a meter, altering a meter reading, unauthorized connections to electrical and thermal networks or other illegal acts, the Electric/Thermal Enterprises and consumers will be subject to administrative and criminal

sanctions established by legislation, similar to those for theft of property belonging to legal entities and individuals.

Article 25: Time for Consideration of Tariffs

After submission by enterprises and organization of all required documents and calculations for tariff consideration, the State Energy Agency under the Government of the Kyrgyz Republic must make a decision within one month. The documents re-submitted for changing tariffs shall be considered by the State Energy Agency under the Government of the Kyrgyz Republic no sooner than 6 months.

Article 26: Accounting Standards

Regardless of legal form or type of ownership structure, all enterprises that generate, transmit, distribute or sell electricity or thermal energy shall keep their books and records in accord with applicable laws of the Kyrgyz Republic taking into consideration internationally accepted accounting standards and practices and, if it is necessary, submit them to audits carried out in accord with international standards and legislation of the Kyrgyz Republic.

Article 27: Separation of Accounts

License Holders that are Integrated Enterprises shall keep separate accounts for each of their activities: Generation, Transmission, and Distribution of electricity and thermal energy, as if they were separate legal entities.

A copy of the annual balance sheet of the enterprise (organization) shall be provided to the State Energy Agency under the Government of the Kyrgyz Republic.

Article 28: Environmental Protection

License Holders should bear the cost of preventing or mitigating pollution from their operations in accord with the environmental protection laws and regulations of the Kyrgyz Republic.

Article 29: Environmental Impact Assessment

The decision to site a new power plant or hydro-electric station shall be subject to an environmental impact assessment prior to the issuance of a construction permit. The assessment reports must be made available to the public and subject to public inquiry in accord with legislation of the Kyrgyz Republic.

Article 30: Crisis Situations

In the event of an emergency or natural disaster, and when the physical safety or security of people, installations or system integrity is threatened, the Government of the Kyrgyz Republic shall take the necessary protective measures and may invoke temporary limitations on the use of electricity. Such measures must cause the least possible inconvenience in the operation of the electricity market and must not be broader in scope than is strictly necessary to remedy the suddenly emerged crisis situation.

Article 31: Responsibilities for Violation of Legislation

Any state, private entity or individual who violates this law, other legislative acts, or Licenses will be subject to material, administrative and criminal responsibilities set by the legislation.

The imposition of fines and penalties through disciplinary, administrative or criminal proceedings will not relieve those entities or individuals found guilty from making restitution in accord with the legislation of the Kyrgyz Republic for the damage caused as a result of the violation.

An energy supplying organization shall be responsible for implementation of a plan for development of the Electric Network, timely and proper repairs and prevention works, and for preparation for work in winter conditions.

Article 32: Dispute Resolution

The resolution of disputes between two or more public entities and between legal entities and individuals engaged in the Electricity sector should not harm the rights and privileges granted to License Holders.

If disputes between domestic and foreign parties concerning the interpretation of rights and duties under a License cannot be settled amicably through negotiation and mediation within a period of three months, either party may choose to submit the dispute to international arbitration in accord with prior agreement.

The State Energy Agency under the Government of the Kyrgyz Republic must establish clear procedures through which conflicts arising between a Captive Client and a Distributor can be quickly resolved.

Article 33: Effect of the Law

This law shall go into effect on the day of publication.

A. Akaev

The President of the Kyrgyz Republic

Bishkek, House of the Government
January 28, 1997
No 8

APPENDIX C. SEA RESOLUTION ON ELECTRICITY TARIFFS

Executive Council of the State Energy Agency
under the Government of the Kyrgyz Republic

Resolution No. 148-P

December 20, 2001 Bishkek City

On Tariffs for Electric Energy

Basing on the cost reports of the energy sector companies for 2002, Executive Council of the State Energy Agency under the Government of the Kyrgyz Republic in accordance with Article 9 of the Energy Law of the Kyrgyz Republic

Decrees:

Electric energy

I. **From March 15, 2002**, to establish the following tariffs for consumption of 1 kWh of electric energy:

	(tiyin)	
	w/o VAT	**w VAT**
1. for residential customers with monthly consumption of:		
a.1) up to 150 kWh	43,0	
a.2) above 150 kWh	80,0	
2. for residential consumers who have 3-phase input using electricity for heating and hot water supply, during heating season:		
With installed capacity from 6 to 10 kW		
- per 1 kW of installed capacity (Som/month)	30,0	
- per 1 kWh of consumed electricity (tyiyn)	50,0	
With installed capacity more than 10 kW		
- per 1 kW of installed capacity (Som/month)	45,0	
- per 1 kWh of consumed electricity (tyiyn)	80,0	
For the rest of the year electricity payment is made in accordance with the point 1)		
3. for industrial and consumers of the same category with contracted capacity of:		
- up to 150 kW per 1 kWh of consumed energy	80,0	96,0
above 150 kW:		
- per 1 kW of contracted capacity (Som/month)	45,0	54,0
- per 1 kWh of consumed energy	70,0	84,0

4. for industrial poultry breeding, dairy production, flour and bread production consumers with contracted capacity of::		
- up to 150 kW per 1 kWh of consumed energy	80,0	96,0
above 150 kW:		
- per 1 kW of contracted capacity (Som/month)	45,0	54,0
- per 1 kWh of consumed energy	70,0	84,0
5. for agricultural consumers with contracted capacity of:		
- up to 150 kW per 1 kWh of consumed energy	80,0	96,0
above 150 kW:		
- per 1 kW of contracted capacity (Som/month)	45,0	54,0
- per 1 kWh of consumed energy	70,0	84,0
6. for pump stations and wells providing irrigation needs within the limits	60.0	72.0
7. for consumers financed from the republican and local budgets:	80.0	96.0
8. for consumers using electricity for cooking purposes with installed capacity more than 6 kW:		
- per 1 kW of installed capacity (Som/month)	45.0	54.0
- per 1 kWh of consumed energy	80.0	96.0
9. for all categories of consumers (residential consumers excluded) using electric energy for heating and hot water supply during winter period with installed capacity of 6 kW and above:		
- per 1 kW of installed capacity (Som/month)	60,0	72,0
- per 1 kWh of consumed energy	80,0	96,0
10. for all consumers (independently from the ownership) using electricity in saunas for heating and hot water supply in order to produce dry (moist) steam during the year:		
- per 1 kW of installed capacity (Som/month)	60.0	72.0
- per 1 kWh of consumed energy	80.0	96.0
11. for all other consumers	80.0	96.0

12. starting from March 15, 2002 section Electricity of the Resolution # 32-p dated March 13, 2001 of the Executive Council of the State Energy Agency under the Government of the Kyrgyz Republic in edition of Resolution # 62-p dated May 28, 2001 becomes invalid.

Director U. Mateev

APPENDIX D. SELECTED PHOTOGRAPHS

Substation “Glavnaya” 220/110/10 kV: existing metering system is outdated and does not support commercial operations in the unbundled electricity sector.

Modern electronic meters must be installed with consistent reading and communication capabilities.

220 kV and 110 kV substations such as one in Bishkek are becoming severely overloaded during peak winter months resulting in increased transmission losses.

Proposed demonstration site in “Uchkun” district near Bishkek: photo shows unauthorized connections to the transformer station.

A meter installed inside customer premises and vulnerable to tampering.

Poor infrastructure creates safety hazards and contributes to facilitate fraud and increase losses.

Poor maintenance leads to serious deterioration at 10/6 kV to 0,4 kV station near Osh.

Efforts to protect meters from tampering at incoming feeders of 0,4 kV substation near Osh.

Efforts by JSC “Oshelektro” to protect meters from tampering by installing them at the electricity pole beyond easy reach.

A multifamily building in Osh where a demonstration project is proposed.

Members of the definitional mission with staff from JSC “Oshelektro”.